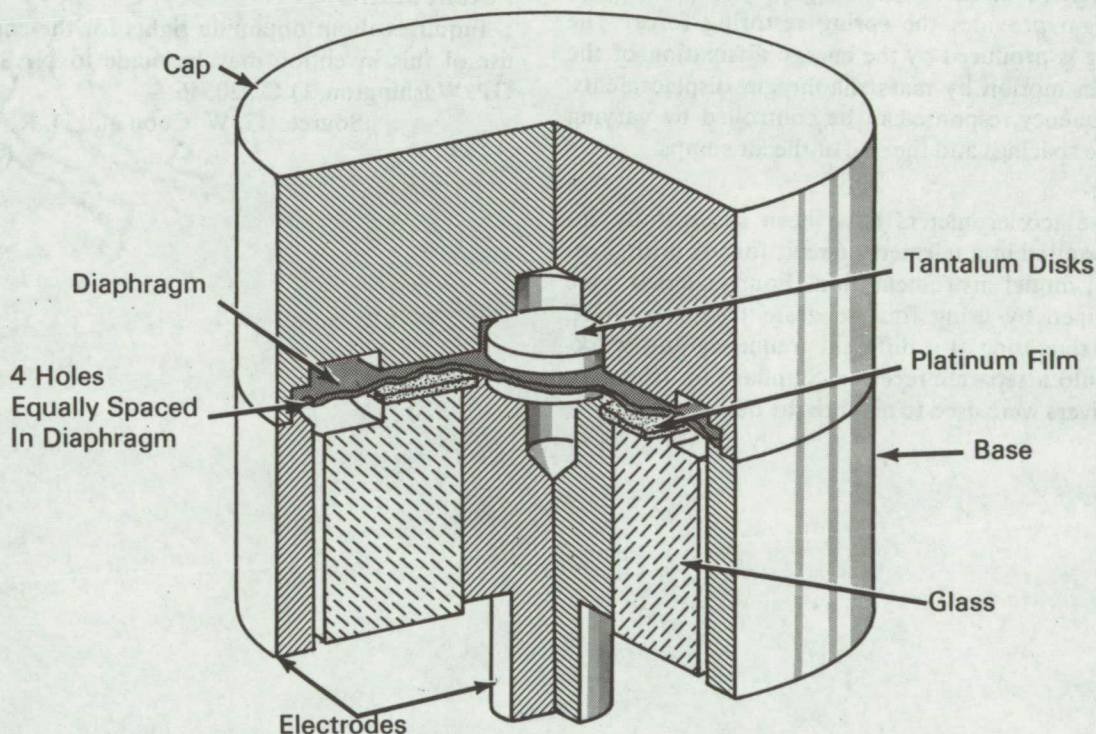


NASA TECH BRIEF



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Miniature Capacitive Accelerometer Is Especially Applicable to Telemetry



The problem:

To design a class of miniature, general purpose accelerometers which are applicable to telemetry and which may be tailored to cover any of a large number of acceleration ranges and frequency responses. The accelerometers must be rugged, easily calibrated, inexpensive, and insensitive to temperature changes.

The solution:

A capacitive accelerometer design which enables the construction of highly miniaturized instruments having full-scale ranges from 1 g to several hundred g.

Frequency responses are flat to 3 percent from 0 to 1000 cycles per second for the lower acceleration ranges and from 0 to 3000 cycles per second for the higher ranges. The accelerometers are 0.25 inch in diameter but have been constructed as small as 0.15 inch in diameter. Since the capacitive transducer modulates the "C" of the "L-C" circuit in the telemetry oscillator, the circuitry is extremely simple.

How it's done:

The capacitive accelerometer senses acceleration as a change in capacitance between a mass-diaphragm assembly and a platinized fixed electrode.

(continued overleaf)

The base of the accelerometer is machined from a commercially available glass-metal, single terminal, electrical feedthrough. A metal diaphragm with equal masses attached to the center of each side is welded at its periphery to the rim of the base. The diaphragm, with attached mass, functions as the variable plate of the capacitor. A metal cap soldered to the base completes the assembly. To provide vibration damping, atmospheric pressure is hermetically sealed inside the accelerometer. Pressure is equalized across the diaphragm by four small holes through the diaphragm.

The mass, spring constant, and required damping are provided in a minimum space. The mass consists of two thin, tantalum discs welded to the center of the stretched circular diaphragm. The prestressed diaphragm provides the spring restoring force. The damping is produced by the energy dissipation of the air set in motion by mass-diaphragm displacements. The frequency response can be controlled by varying the plate spacings and the size of the air sumps.

Notes:

1. These accelerometers have been successfully incorporated in a telemetry circuit for use with free-flight model instrumentation. Four channels were obtained by using four separate telemeter units, each operating at a different frequency and working into a separate receiver. Standard fm telemetry receivers were used to acquire the data.

2. The capacitive accelerometer has proved to be rugged, applicable to low or high g measurements, easily calibrated, and of adequate linearity and frequency response.
3. This capacitive accelerometer is similar to a capacitive pressure cell described in NASA Tech Brief B63-10429, "Welded Pressure Transducer Made as Small as 1/8-inch in Diameter," March 1964.
4. Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: B66-10491

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C., 20546.

Source: G. W. Coon and D. R. Harrison
(ARC-72)